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CALIFORNIAN OLIVELLAS

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The following paper presents further data on *Olivella biplicata,* a species already considered in our two earlier papers,[1] and a discussion of the variation in *Olivella pedroana*[2] and *Olivella pycna.*

Olivella biplicata

On August 26, 1942, a large series of young of this species was collected at Crescent City, Del Norte County, while we were gathering *Olivella pycna.* The young *biplicata* were approximately of the same size as the *pycna,* so we garnered both species, especially since the indication in each case was the same; namely a small ridge in exposed sand, a groove in sand in pools. The larger ridges we assumed were all made by adult *biplicata.* This large series of young *biplicata* (now in the collection of Mr. Allyn G. Smith) suggests that summer is the breeding season for this species at Crescent City.

On May 22, 1943, we visited Santa Cruz, Santa Cruz County, and there saw many hundreds of this species. Large numbers were seen in tidal pools, while others were exposed by raking the sand with our fingers. In all only three very small young ones were seen. The adults, however, were apparently breeding, for we found many couples in contact. In the large series of adults observed we discovered four orange-colored individuals, but these

[1] Color Variation in *Olivella biplicata,* The Nautilus, vol. 55, pp. 10–12, 1941; Color Variation in *Olivella biplicata* in Various Localities, The Nautilus, vol. 56, pp. 43–48, 1942.

[2] We are leaving to the taxonomists the moot question of whether this species should be called *pedroana* or *baetica* (*boetica*), or whether these two names stand for two distinct species. All our shells called *pedroana* appear to be but a single species.

had more or less purple in the canal region, so that none was truly comparable to our unique orange shell from Bolinas, which lacks all trace of purple. They are, however, similar to a second [3] Bolinas orange specimen with purple in the canal region.

At Monterey, Monterey County, on November 21, 1942, there were no small young shells of *Olivella biplicata*, but a considerable number of half-grown ones was taken. Since we do not know the rate of growth of this species, we are still uncertain as to the breeding season at Monterey, but assume that it may be summer.

Our 1942 paper on color variation in this species lacks adequate series south of Santa Barbara. Hence, the following are of interest. At Anaheim Landing, Orange County, on January 31[4] and February 2, 1943, eleven adult shells were taken, one albino, the others of normal coloration. These lack any trace of orange in the aperture, but (with the exception of the albino) have much purple on the inner surface of the body-whorl. A series of 267 young shells was collected, ranging from tiny individuals with striped ventral surface to others a third grown. Out of the total of 278 specimens (adult and young) none shows orange in the aperture. Of this total sixteen are albinos, thus yielding a frequency of about six per cent. This correlates with the five per cent occurrence at Santa Barbara.[5] Sixteen dark, steel-gray, young and immature shells were taken. The remainder of the series is "normal" in coloration. The evidence seems to point to a winter breeding season at Anaheim Landing, as at Santa Barbara.

From False Bay, San Diego County, we now have a series of twenty-five. Twenty-two of these were collected by Miss Edna N. Wilson on January 21, 1943, and three by ourselves on February 3, 1943. None of these twenty-five shows any trace of orange, nor do four specimens previously recorded from Ensenada, Lower California. Two False Bay specimens are albinos, thus yielding a frequency of eight per cent, which is probably much nearer the truth than the twenty-five per cent for Ensenada

[3] The Nautilus, vol. 55, pp. 10–12; vol. 56, p. 44.

[4] Our thanks to Mr. and Mrs. John Q. Burch for taking us to this collecting ground.

[5] The Nautilus, vol. 56, p. 45.

based on one out of four specimens.[6] Eight per cent is not far from the six per cent frequency of albinos at Anaheim Landing and the five per cent at Santa Barbara. These figures (8, 6, 5) probably give an approximate idea of the frequency of albinos on the southern Californian and northern Lower Californian coast.

Apparently corroborative of a probable winter breeding season at Bolinas[7] is a considerable number of one-third grown shells collected at Bolinas on May 23, 1943. We are assuming that these may represent winter-hatched shells. However, after writing the above statement concerning May 23, we spent June 18–21, July 18, and August 15, 1943 at Bolinas in search of *Olivella pycna*. In the course of collecting the latter, we handled many young *Olivella biplicata*, which would seem to indicate a late spring, as well as a winter, breeding season at Bolinas, or perhaps the breeding is continuous through several months.

The late Mr. T. S. Oldroyd has described and figured, on the bases of shape and size, a number of "varieties" of *Olivella biplicata*.[8]

The figure (pl. 5, fig. 5) which Oldroyd presents as typical for Monterey is a bit too obese to be typical, but it does fall within the range of shapes for the locality. His figure indicates the breadth as 58 per cent of the length. Our specimens from Monterey range from 50 to 60 per cent in breadth-length index (i.e., breadth divided by length).

Oldroyd's figure (pl. 5, fig. 4) of his *Olivella biplicata fucana* yields an index of 51; his measurements (p. 118) yield an index of 50. Suggesting these in relative slimness and height of spire is our series from Port Orford, Curry County, Oregon: broadest with index of 55, narrowest 44.

Oldroyd's figure (pl. 5, fig. 6) of his *Olivella biplicata angelina* yields an index of 48; his *Olivella biplicata parva* (pl. 5, fig. 7) an index of 62. His length and breadth figures for the type, p. 119, however, yield an index of 57, suggesting that the figure in the plate has been retouched badly. From Southern and Lower

[6] The Nautilus, vol. 56, p. 45.

[7] The Nautilus, vol. 56, p. 47.

[8] Some Varieties of Western Olivellas, The Nautilus, vol. 34, pp. 117–119, pl. 5, 1921.

California our series yield the following ranges in breadth-length index: Morro Bay 51–58; Santa Barbara 50–60; Anaheim Landing 47–55; Mission Beach, False Bay 48–58; Ensenada, Lower California 49–52.

At Bolinas, Marin County, the range in breadth-length indexes is 48–59; at Tomales Bay, Marin County, 49–57; at Trinidad Head, Humboldt County, 50–62; at Crescent City, Del Norte County, 48–57; at Santa Cruz, Santa Cruz County, 52–62.

Scanning large series from various localities, one is impressed with the relative obeseness of Monterey, Santa Cruz, and Trinidad shells, the relative slimness of Port Orford, Bolinas, and southern Californian shells. The mean figures from south to north are as follows: Ensenada 50.5, False Bay 53, Anaheim Landing 51, Santa Barbara 55, Morro Bay 54.5, Monterey 55, Santa Cruz 56, Bolinas 53.5, Tomales Bay 53, Trinidad 56, Crescent City 53.5, Port Orford 49.5.

The range in shapes represented by the above breadth-length indices seems to indicate that Mr. Oldroyd dignified mere individual variations by names, rather than geographic variations. Thus, his Monterey "typical" specimen with index 58 could have come from False Bay, Santa Barbara, Morro Bay, Santa Cruz, Bolinas, or Trinidad. His *fucana* type with index 50 or 51 could have come from Port Orford, Crescent City, Trinidad, Tomales Bay, Bolinas, Morro Bay, Santa Barbara, Anaheim Landing, False Bay, or Ensenada. His *angelina* with index 48 in the figured specimen could have come from Ensenada, False Bay, Anaheim Landing, Bolinas, Crescent City, or Port Orford. Similarly, his *parva* type with index 62 from his figure, or 57 from his measurements, could have come from various places other than Point Abreojos, Lower California.

Olivella pedroana

We are using the name *pedroana* instead of *boetica* or *baetica* on the assumption that both names apply to the same species, Conrad's name *pedroana* being the earlier.

Our personally collected littoral series of *pedroana* are from Anaheim Landing, Orange County (986 specimens), January 31 and February 2, 1943, and from Mission Beach, False Bay, San

Diego County (156 specimens), February 3, 1943. Miss Edna N. Wilson, our hostess and guide at Mission Beach, contributed 419 additional specimens from that locality. Our Anaheim Landing series was increased by seven specimens from Mr. and Mrs. John Q. Burch, who had collected them in October, 1940.

The Mission Beach shells are in general larger than those from Anaheim Landing. On the whole *Olivella pedroana* has a higher gloss and more porcelaneous surface than *Olivella pycna*. The color range is much greater also, being from white (albino) to chestnut brown and deep grayish olive. The commonest colors are Ridgway's olive lake, smoke gray, and light grayish olive. Moreover, examples with pale blue coloration (mostly burn blue) were common. No xanthochroistic specimens were seen, unless one considers as such a few specimens that match buffy olive, cream buff, chamois, and cartridge buff, not all over but in patches. The pattern of brown markings in some instances suggests somewhat that of the vertical wavy lines of *Olivella pycna*, especially in some grayish-olive specimens from Anaheim Landing. Other shells of this color are virtually without markings. In some shells, particularly albinistic or pale bluish ones, the markings may take on a partial plaid or checker pattern. Dredged shells (from the Burches) are frequently reddish brown in general color, a feature noted also for dredged specimens of *Olivella pycna*. The nearest approach we have in a littoral specimen is light vinaceous gray. None of our *pedroana* has the reddish brown spot alongside the fold at the base of the columella, which is so common in *pycna*. The colors described above are not over the entire shell, but chiefly on the body whorl.

The color of the inner surface of the body-whorl varies with the color of the exterior. Albinos are white, darker shells have dark coloration on the inner surface.

Certain specimens of *Olivella pedroana* have a lip callus on the inner surface of the body whorl. It is in the form of a ridge lying roughly parallel to the lip and a millimeter or so within, but not extending for the full length of the lip. It is usually white, in which case it can be readily seen. But, whether white or blending in color with the surrounding surface, it can be felt with a pin point moved transversely over the inner surface of the shell. It occurs most frequently in False Bay specimens.

45 per cent of them having it, as against a frequency of only six per cent in Anaheim Landing specimens. These are the only localities from which we have adequate series of specimens (575 from False Bay, 993 from Anaheim Landing).

In certain smaller series, which we have received from generous friends, the callus occurs. From Newport Bay, Orange County, a series of 72 from Mr. Allyn G. Smith shows a frequency of 4 per cent. From San Pedro, Los Angeles County, 10 fathoms depth, a series of 11 specimens from Mr. and Mrs. John Q. Burch contains two specimens with the lip callus. Three Redondo Beach, Los Angeles County, dredged series from the Burches show the following frequencies: 15 fathoms, 17 specimens, none with callus; 20 fathoms, 118 specimens, 1 with callus; 25 fathoms, 39 specimens, 1 with callus. Five specimens from San Diego Bay, also from the Burches, lack the callus.

Mr. Walter J. Eyerdam has sent us Alaskan specimens, all lacking the lip callus: 11 from Hinchinbrook Island; 12 from Drier Bay, Knight Island, Prince William Sound.

To the eye, *Olivella pedroana* is distinctly slender, *Olivella pycna* obese. Relatively stout specimens of *pedroana* and relatively slender specimens of *pycna* suggest the possibility of overlapping, but so far as our series are concerned there is no overlapping. The range of shapes, expressed by the breadth-length index, is 36 to 47 for *pedroana*, 49 to 58 for *pycna*. The proportion of lip length to shell length, however, has virtually the same range in the two species. For *pedroana* lip length ranges from 51 to 67 per cent of shell length. For *pycna* the range is 54 to 66 per cent.

The fold at the base of the columella is usually slightly reflexed in both species. It tends to be thick in *pedroana*, delicate by comparison in *pycna*. On the whole *pycna* is a thinner shell than *pedroana*.

Olivella pycna

Described as a hitherto unrecognized species by Dr. Berry,[9] this species seems to be valid, and so far as our series of specimens are concerned does not intergrade with *Olivella pedroana*,

[9] S. Stillman Berry, An Undescribed Californian Olivella, Proc. Malacological Society, vol. 21, pp. 262–265, 1935.

which is presumably its nearest relative. At least the series of more than a thousand *pycna* which we have collected alive, chiefly at Crescent City, Del Norte County, and at Bolinas, Marin County, appears distinct from a series of more than a thousand *Olivella pedroana* which we took at Anaheim Landing, Orange County, and at Mission Beach, False Bay, San Diego County. Apparently Dr. Berry has clarified the *Olivella* situation in California. We have nothing to add to his discussion of the literary references, except to remark that the four *Olivella boetica* pictured by T. S. Oldroyd [10] do not appear attributable to *pycna*, but to *pedroana*, using that name as a prior synonym for *boetica*.

The lip callus frequently present in *Olivella pedroana* is absent in all of the 1149 *Olivella pycna* in our collection. The aperture opening in *pycna* is larger in proportion to the shell than in *pedroana* which is notably slenderer than *pycna*. Also the lip callus in many *pedroana* reduces still further the size of the aperture.

In coloration, or better color pattern, *Olivella pycna* is relatively uniform. There is no such color range as in *Olivella biplicata* or *Olivella pedroana*. A single xanthochroistic *pycna* is the only departure from the normal color range. The color brownish buff described by Dr. Berry, as in the paratype which he kindly presented to us, appears chiefly in our younger specimens. Our older specimens have more of a glaucous gray or olive gray ground color.

Under date of August 1, 1943, Dr. Berry writes us: "So far as I am aware all of my paratypes, inclusive of yours, are shells collected in the living state, or if any of them were dead shells I feel sure they were not long dead. I wonder whether the difference in coloring noted by you may not be due either to the time that my shells have been cabinet or else to the fact that they were all dredged or trawled shells." Dr. Berry writes that he used Robert Ridgway, Color Standards and Color Nomenclature, 1912, in determining colors. We are using the same work in this connection.

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[10] T. S. Oldroyd, Some Varieties of Western Olivellas, The Nautilus, vol. 34, pp. 117–119, pl. 5, figures 1, 1a, 2, 3, 1921.

Our single xanthochroistic specimen is capucine buff in general color, with the vertical striping obsolete and discernible only as a slightly different tone. The interior of the aperture is even richer in color than the exterior.

The brown zigzag lines running longitudinally on the shell vary in spacing and in the extent of the zigzag or wave. In some cases the lines are veiled by glaucous gray or olive gray ground color, which seems most prevalent in the older and thicker shells. In the thin young shells the brown lines are most conspicuous and equally clear from inside or outside of the shell.

A color character, not mentioned by Dr. Berry, but occurring in 72 per cent of our specimens, is a maroon or reddish brown spot, sometimes obsolete or veiled by white, beside the fold at the base of the columella. This feature is absent in four dredged specimens from Tomales Bay, Marin County, presented to us by Mr. Allyn G. Smith; in our single specimen from Port Orford, Curry County, Oregon; and in the afore-mentioned paratype. It is present in some of the shells from other localities ranging from Morro Bay [11] in the south to Crescent City in the north.

The following are the dates and places we have collected *Olivella pycna* alive littorally: Port Orford, Curry County, Oregon, June 10, 1941, 1 adult specimen; Crescent City, Del Norte County, June 9, 1941, 7 adult specimens; August 26, 1942, 650 specimens, many immature and young as well as adults; Bolinas, Marin County, May 23, 1943, 2 adults; June 18–21, 1943, 357 adult, immature, and a few young specimens; July 18, 1943, 79 adult and half grown specimens; August 15, 1943, 6 adult and half grown specimens; Monterey, Monterey County, May 31, 1942, 24 adult and immature specimens (including the adult xanthochroistic one already mentioned); November 21, 1942, 6 adult specimens. This gives a time range from May 23 to November 21, for littoral occurrence, with the peaks of abundance at Bolinas in latter June and at Crescent City in latter August.

[11] We are indebted to Mr. and Mrs. John Q. Burch for Morro Bay and Morro Rock specimens, the latter dredged from seven fathoms.